



Missouri Department of Natural Resources

Total Maximum Daily Load Information Sheet

Mississippi River

Waterbody Segment at a Glance:

County: Jefferson
Nearby Cities: Herculaneum
Length of impairment: 5 miles
Pollutant: Lead and Zinc
Source: Herculaneum Smelter



Proposed for addition to the 2002 303(d) list

TMDL Priority Ranking: High

Description of the Problem

Beneficial uses of Mississippi River

- Livestock and Wildlife Watering
- Protection of Warm Water Aquatic Life and Human Health associated with Fish Consumption
- Irrigation
- Boating and Canoeing
- Drinking Water Supply
- Industrial

Use that is impaired

- Protection of Warm Water Aquatic Life and Human Health associated with Fish Consumption

Standards that apply

- Missouri Water Quality Standards (WQS) do not contain numeric criteria for metals in sediment. The high levels of lead and zinc represent a violation of the general criteria found in the WQS 10 CSR 20-7.031(3)(D) where it states:
 - Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal or aquatic life.Also in WQS 10 CSR 20-7.031(4)(B)1 it reads:
 - Concentrations of [contaminants] in bottom sediments or waters shall not harm benthic organisms and shall not accumulate through the food chain in harmful concentrations, nor shall state and federal maximum fish tissue levels for fish consumption be exceeded.

Wet weather runoff from the Herculaneum smelter flows directly into Joachim Creek. Attempts to analyze sediment from Joachim Creek have failed due to a lack of fine sediments in the river

downstream of the smelter. Instead, these metals have been detected in the Mississippi River below the confluence with Joachim Creek. Levels of **zinc** reported in Mississippi sediments (see table below) are above values commonly reported as toxic to aquatic life. Factors such as hardness, dissolved oxygen and temperature can affect the toxicity of zinc to aquatic life. Synergistic effects, a negative impact greater than the sum of the individual components would indicate, can also increase zinc toxicity¹. Zinc is an essential nutrient to aquatic and terrestrial organisms, but in excess quantities can be highly toxic and can bioaccumulate (a process where toxic substances become concentrated in living organisms). A number of behavioral and physiological effects have been reported when test organisms have been exposed to increased zinc levels. Behavioral responses in fish include avoidance and changes in feeding rate and movement patterns. Physiological changes in fish include increased ventilation rates, frequency of coughing and a decrease in oxygen utilization.²

In addition, fish tissue sampling by the U.S. Fish and Wildlife Service showed higher levels of **lead** in fish downstream of the smelter, 2.59 mg/kg, than upstream, 0.17 mg/kg. Note: Milligrams per kilogram (mg/kg) is the same as parts per million. Consumption of fish with sufficient quantities of lead may cause human health problems. In humans, lead primarily affects the nervous system, blood cells, and processes for the metabolism of Vitamin D and calcium. Lead can affect the developing fetus during pregnancy and may cause lower IQ scores in children. Lead poisoning may also result in poor attention spans, hearing, speech and language problems, reading disabilities, reduced motor skills and poor hand-eye coordination. Evidence suggests that lead toxicity may occur at levels as low as 10 micrograms per deciliter (µg/dL) of blood.

The Missouri Department of Health and Senior Services (DHSS) screened children for lead in “old” Herculaneum, which is defined as within a mile of the smelter, in August 2001.³ Of the twenty children screened, 25 percent had lead poisoning or 10 µg/dL blood lead levels or higher. A second blood lead screening was conducted in October due to high levels of lead contamination found along the haul routes of Herculaneum. On Feb. 26, 2002, DHSS released a Health Consultation that contained the results of their blood-lead census and other sampling conducted in those two screenings. Overall the rate of elevated blood-lead (over 10 µg/dL) in children 6 years of age and under in Herculaneum was 28 percent. The rate of elevated blood-lead in children residing east of Highway 61-67 was 45 percent, which is the highest recorded in the state. Children under the age of six are of particular concern because of the negative effects that lead has on developing nervous systems.

The DHSS Health Consultation determined a circle of contamination existed around the smelter. The elevated blood levels in children under 6 years of age were:

- 23 percent - between 1 mile and 1 ¼ mile of the smelter
- 20 percent - between ¾ and 1 mile of the smelter
- 35 percent - between ½ and ¾ mile of the smelter
- 52 percent - between ¼ and ½ mile of the smelter
- 56 percent - within ¼ of the smelter

¹ Upper Sacramento River TMDL for Metals, California Environmental Protection Agency, 9/25/01.
www.swrcb.ca.gov/rwqcb5/TMDL/upperSacCdCuZn.html

² Red Clay Creek TMDL, Delaware Natural Resources and Environmental Control, 8/1/99.
www.dnrec.state.de.us/DNREC2000/Library/Water/rcctmdl.pdf

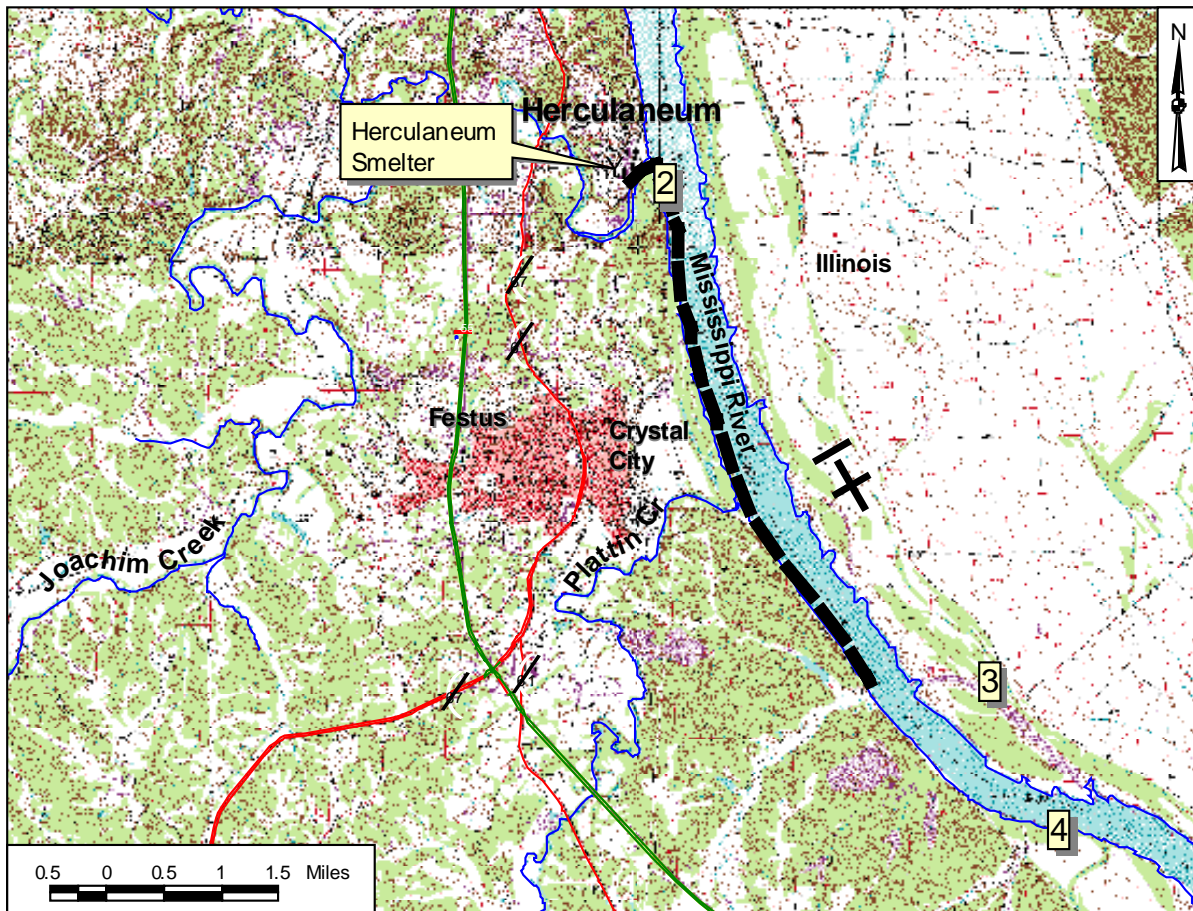
³ Phone conversation November, 2001, with Angela Minor, DHSS St. Louis Office

DHSS is planning to conduct another screening in the fall of 2002.

The department has developed a sampling plan for the Herculaneum area. The purpose of this plan is to determine the impact of the Doe Run lead smelter on the levels of metals and other pollutants in the waterbodies of this area. Water and sediment samples are being collected at various locations in an effort to determine if a pattern of deposition exists. Joachim Creek and the Mississippi River are included in this sampling effort. The data will be used to determine if operational changes are needed at the Herculaneum Smelter. The Missouri Department of Conservation will continue to monitor fish tissue as part of this sampling plan.

Sampling Sites on the Mississippi River

Note: Site #1 is off the map upstream of the Herculaneum smelter



----- Impaired segment

→ Direction of Flow

Sample Sites on the Mississippi

- 1 – River Mile 160, near Meramec River (not shown)
- 2 – River Mile 152, near Herculaneum Smelter
- 3 – River Mile 146.2, Osborne Channel (Illinois side)
- 4 – River Mile 145, La Rouche (behind short wing dam)

Metals in Mississippi River sediments, 1995
(mg/kg, dry weight)

Site #	1	2	3	4
Arsenic	4.9	15	5.2	4.3
Cadmium	0.7	33	32	<0.2
Chromium	20	25	25	27
Copper	18	1,060	1,030	13
Mercury	0.04	0.03	0.06	0.04
Lead	37	7,720	7,590	23
Nickel	22	98	92	13
Zinc	101	29,400	28,800	84

Source: Mike Coffey, U.S. Fish & Wildlife Service

For more information call or write:

Missouri Department of Natural Resources

Water Pollution Control Program

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